

Building bridges: authentic problem solving in a community of learning

Craig Baird

Curtin University of Technology, Perth, Australia
c.baird@curtin.edu.au

Dr Kerry Pedigo

Curtin University of Technology, Perth, Australia
pedigok@cbs.curtin.edu.au

Abstract: *The use of authentic tasks to facilitate experiential learning has been shown to be effective in many studies (Baird & Fetherston, 1999; Berryman, 1991; Carver, 2001; Collins, Brown, & Newman, 1989; Duncan, 1996). This paper discusses how an authentic activity was used to introduce, develop and implement a collaborative learning approach for a short, intensive, mostly IT-based programme, for a group of post-graduate trainers and facilitators from disparate backgrounds. Team-based learning activities were used to encourage collaborative interaction between students through peer mentoring. Formative feedback on ideas was explored, and potential solutions presented, when investigating real tasks and emergent problems.*

Keywords: *authentic tasks, collaborative learning, peer mentoring*

Introduction

Information obtained during discussions held with a group of postgraduate students, from disparate discipline areas, was used to inform the development of a new IT-focussed summer school unit. The unit thus created was designed to facilitate student acquisition of IT skills through the use of authentic tasks in a team-based, collaborative learning situation. The approach chosen involved a group of tasks that required student use of a suite of computer software applications typically required in their everyday work situations. The authentic tasks devised for this unit were implemented through group-based activities built around a simple real-task classroom exercise. Key also to the learning situation was the use of peer mentoring and team-based methods to solve real problems in ways that might also be readily applied by graduates when faced with authentic problems in workplace settings.

The learning situation

The student cohort

The student cohort consisted of 42 teachers and trainers from 18 discipline areas. Initial discussions with the group revealed that collectively they had diverse knowledge and skill

levels when it came to IT, working with groups, or in directing others in learning institutions, commercial businesses, industrial settings and military workplaces.

The setting

Some aspects of the unit, such as the time and duration, had already been locked in place and these affected elements of the design and implementation of the learning activities planned. The unit was to be run over four successive Saturdays from mid January to mid February. Being the summer-break period for most of the participants added to the imperative to develop a learning situation that kept participants focused on learning activities that facilitated the development and application of IT skills for research, problem solving, and the presentation of solutions. The unit setting was constructed to support learning in a collaborative community of practice where imaginative ideas could be freely shared along with IT-based ways for resolving and presenting solutions to emergent problems.

Aims and desired outcomes

This intensive unit sought to cater for a broad range of individual differences in student discipline areas and workplace roles required of the student participants. It also sought to accommodate students' differing levels of ability when using computer technology to search out and apply information for solving authentic problems. Tasks developed for the unit were designed to encourage student presentation of multiple perspectives, personal views, and innovative solutions. It aimed to have students use IT as a tool to facilitate problem-solving strategies rather than as discrete knowledge or procedures.

In addition to developing the students' tacit knowledge and IT skills, the unit sought to develop a community of learning within the overall student cohort through student participation in collaborative teams working on authentic tasks. Learning activities were planned to incorporate role sharing and role changing so that each of the participants might experience multiple responsibilities, undertake peer mentoring, conduct individual research and contribute to shared activities within each group. Activities were also designed to encourage and reward students for contributing to, and for consulting with, other groups within the overall cohort. Emphasis was placed on student use of reflection (Brown, Collins, & Duguid, 1989) and exploration (Carver, 2001) when giving feedback to others in each of the small groups and in presentation and debriefing sessions held with the entire student cohort at times throughout the duration of the unit. For this purpose, a journal (using both IT methods and hand written notes and sketches) was incorporated into learning tasks and assessment presentations for Activity 3.

Planning the learning tasks

Learning activities were based on resolving authentic tasks. Given the very diverse nature of the student cohort, it was decided to use a simple bridge design and construction activity that all of the group members could work on in ways that promoted collaborative small group practices, while providing opportunities for individual creativity and use of different skills. This would also allow students to explore at their own level and pace. They could acquire and apply IT knowledge and skills in a non-threatening situation that encouraged them to seek assistance from others as well as to provide help to others in a community of learning.

The four-day unit was constructed as shown in Table 1, with appropriate breaks. In this paper only the first day's tasks, being Activity 1 and Activity 2 are discussed, as it is the

application of the bridge-building group of tasks (Activity 2) that is being explored here as a tool for facilitating a community of learning through authentic problem solving and interactive team-based learning.

Table 1: Schedule of activities

Day	Session 1: 1.5 hrs	Session 2: 1.5 hrs	Session 3: 1.5 hrs	Session 4: 1.5 hrs
One	Activity 1: Introduction to group and self profiling (all members)	Activity 2 Establishing teams – commencing bridge design and resourcing	Role changing in groups – research using Internet, WORD, EXCEL, Powerpoint	Assisting others with IT methods – peer mentoring – presentation of Activity 2 design solutions
Two	Each student to present their Activity 3 topic – total group feedback and suggestions		Individual research session with peer mentoring and group discussions	Debriefing and reflection session to refine research of individual student topics
Three	Individual student progress reports and o/a group formative feedback	Individual research session with peer mentoring and group discussions	Show and tell use of IT by students to demonstrate new information or skills	Debriefing and reflection demonstration of special IT presentation elements
Four	Presentation of Activity 3 solutions and formative feedback sessions			Reflection and projection – where to now?

Implementation

More than twice the expected number of students attended the unit. Although this caused a few busy minutes in organising the physical environment, it did not negatively impact on the androgogical (Mezirow, 1996) situation because of the flexible nature of the learning approach taken. On reflection it appeared to add to the rapid establishment of a sense of purpose in the overall student cohort, and willingness to form cooperative groups when called upon in this technologically rich (Jarvela, 1995) learning environment.

Activity 1

As shown in Table 1, the unit commenced with a relaxed open discussion (Activity 1) in which all of the participants introduced themselves with a brief self-profile and comment on what they sought from attending the unit. Information thus attained was used to refine tasks planned for the rest of the unit, and the manner in which those tasks were to be moulded to individualise student learning and to optimise the time, resources and intellectual capital of the student cohort.

From this first session alliances were made and eight groups of five (+) students were established by aligning those with self-proclaimed high IT skills with those who considered themselves to have low IT skills. This was achieved by having the students arrange themselves in a line beginning with high IT skills at one end of the room, and low IT skills at the other end, then forming groups by taking students from each end of the line and the middle in sequence until all were grouped in the eight teams. This approach proved to be a relaxed and

often humorous, non-threatening, student-controlled means for establishing teams, and the beginning of a community-of-learning environment.

Activity 2

Activity 2 was made up of a group of tasks. The first task involved students working in groups of five to design and construct a 300mm span bridge from drinking straws with a view to making it capable of supporting the weight of a 25mm thick book. All of the materials needed were provided, and each was costed according to a pricing schedule to which the students were required to adhere. This experiential learning activity has been used by others as an icebreaker or for teaching group processes (c.f., Hudson & Jay, 2001; Sorohan, 1994) and for other different applications. The task of designing and constructing the bridge was a simple authentic (real) activity that provided opportunities to connect with a number of other IT-based tasks that formed the core of team-building collaborative activities. These activities were organised to assist students to acquire knowledge and skills in using various software packages and presentation methods.

Together, the bridge-building exercise and associated IT-based activities were thought to support student group interaction, peer mentoring, task-focussed multiple role experiences, and student use of multiple computer applications for finding, developing and presenting information. The brief for the group of IT-tasks used in Activity 2 is provided in Box 1 below.

Implementation of Activity 2

Working in groups of five, the students were required to collaborate on the design and construction of a bridge while each taking turns at individual and paired roles including bridge designer, constructor, materials sourcing, and process recorder. Roles were rotated so that all team players had the opportunity to participate in the numerous tasks required to complete the activity of building the bridge and in the documentation and costing of its construction. Some of the team roles represented Belbin's (1981, in Fisher, Hunter, & Macrosson, 2000) proposed roles such as, resource investigator and team workers. This was particularly important in having everyone experienced in each of the components. For example, searching for information (resource investigator), leading the group (chairperson), managing the finances, building the bridge (team worker).

In addition to these task-focussed roles, each student was also required assume responsibility for:

- Using the Internet to research information about bridge design and construction; finding suitable images for presentation of ideas; and, confirming reference materials to support their design;
- Maintaining a computer-based journal (using a word processor with defined formatting);
- Maintaining a spreadsheet showing all materials and their cost (according to a defined schedule) used in the construction of the group's bridge;
- Contributing to a Powerpoint slide show to be used for a group presentation of the design, construction and testing of the bridge;
- Using a digital camera to record each phase of the design and construction of the bridge;
- Using a computer scanner to incorporate hand sketches or notes created by the group into the project journal and word-processed report;

- Contributing to a report-styled, word-processed document containing illustrations and picture depicting all aspects of their group activities; and
- At the conclusion of the bridge building activity, each student was required to participate in a presentation and Powerpoint show in which the research, design, construction, testing and group analysis of the overall activity was presented.

Throughout the design, construction, and testing of the bridge, each student in the group was encouraged to mentor others (in their own and in other groups) wherever possible, so as to share their knowledge and skills in the use of computer technology. They were also encouraged to seek the help of others when needed. A reward system was included in the task brief (See Box 1: Bridge Project Brief) to encourage each of these activities. Working in this manner was thought to assist the students in the development of their IT knowledge and skills, while allowing them to maintain their own pace and level of learning within their small collaborative groups and thereby retain ownership of their learning process and individual expression in the bridge design project.

Throughout the building and testing of the bridge, the students also used a digital camera to record their activities. Figure 1 shows one group of students working with a journal recorder (left of picture) three students building components, and one student keeping the costing spreadsheet (right). The students' integrated photographs such as this (and Figure 2) into their documents and presentations.



Figure 1: Students working on the bridge design/construction task

The Bridge Project Brief details the design brief and guidelines for the documentation and costing elements used to embed IT skills and group interaction. This bridge-building activity has been adapted from one developed by Bronwyn N. Hudson, and Leighton Jay of Curtin Business School, Curtin University of Technology.

Activity 2 - Bridge building and IT group of tasks – STUDENT BRIEF

Form a group of up to five people. Together you will design and build a bridge to span at least 300 mm, and be capable of supporting the weight of a book as supplied by the workshop facilitator. In addition to the design and manufacture of the bridge, you must document all aspects of your research and development processes using WORD, EXCEL, and POWERPOINT. You will use this documentation to provide a five-minute presentation to the overall class group at the end of the designated activity.

Rules for all teams

1. All teams start with a budget of \$1500
2. Each dollar your team spends on their bridge has to be accounted for. Someone in the team will need to keep a running total of all costs. Failure to do this could result in a fine of \$200 against your team.
3. Your team's bridge must be a minimum of 100 mm high, have a clear span of at least 300 mm, and be able to sustain the weight of a textbook on top for 2 minutes.
4. The only items to be used in building the bridge are
 - a. Plastic straws - \$10.00 each
 - b. Sticky tape - \$30.00 per 10 cm piece
 - c. You can lease a pair of scissors for \$20 for 5 minutes
 - d. The textbook for testing your tower is free however each performance appraisal will cost your team \$200

You will receive a performance bonus if you achieve your objective. Your performance bonus will be 50% of your remaining budget.

Note the following points:

- All costs must be documented using a spreadsheet or WORD document table.
- Throughout the course of your design and construction, you are required to use the Internet to source information that will assist in the design and construction of the bridge, and later for your presentation and defence of the methods employed. Pictures, drawings, structural or historical information of all types may be used to enhance your design and presentation.
- At times throughout this exercise you may seek advice or assistance from persons in other teams operating in the overall class group. When this occurs, you must record the type of assistance that you were given, and then **add \$5** to your budget for each instance. When you provide information or advice to others outside of your group, you may **add \$10** to your budget. Please note that you may be called upon to **defend** such inclusions
- Information and resources such as Web links, photographs and drawings etc. obtained as part of your research for this activity may be presented in your WORD document or as part of your POWERPOINT slide show for a \$100 bonus.

Debriefing

At the end of each presentation session we will discuss the following:

- What happened in your team
 - o levels of participation, involvement, ownership of the project
 - o How did each of the team members feel about their role in the team structure
 - o feelings over goal achievement or lack of
 - o levels of enjoyment (different leadership styles yield different group experiences)
- Did a leader emerge, or was it a fully collaborative effort with each member contributing equally?
- Was the style of leadership appropriate to the task/situation
- Discussion of interaction (and effectiveness) between teams and support exchanged by individuals
- What did you learn today that you could not do successfully yesterday?
- Was there any conflict? How was that dealt with?

Box 1: Bridge project brief for Activity 2

The photograph shown below as Figure 2 depicts one group who successfully tested their bridge as required by the task brief. Some of the testings were not so successful!



Figure 2: Students successfully testing their constructed bridge

Outcomes

The bridge-building exercise with its multiple IT elements was used to facilitate a range of authentic activities in which students were encouraged to work collaboratively in groups and to share their special skills with others through peer mentoring. It provided a vehicle for students to experience and apply a broad range of IT tools in the research and presentation of an authentic task involving word processing, spreadsheet calculations, graphical presentation, web-page design, scanning, digital camera use, and internet searching. Of special value was its use in facilitating a learning situation in which students developed a community of learning. In this setting the students worked in ways that allowed for individual learning styles and pace of learning, while having the support of others from within each team-based group, as well as from the overall student cohort.

At the conclusion of Activity 2, each five-student team made a ten-minute presentation detailing the design, construction, testing and accounting (costing and materials use) for their bridge. Throughout the presentations each of the students was also encouraged to present their views on the process of working in groups and what that had meant to them in terms of collaborative learning, team roles, the development of their IT knowledge and their use of reflection and exploration to refine and extend their design and presentation methods. This was further explored in a debriefing session at the end of the day.

Activity 2 was conducted over one full day so that the students had time enough to experience multiple roles within their team/group and thereby entertain different learning styles and rates as they researched, resolved, and documented emergent problems and solutions. Having this extended time frame, compared with the ways in which others have used the bridge building exercise (Hudson & Jay, 2001), facilitated student development of the knowledge and skills needed to resolve emergent problems with the help of others, and through reflection and exploration. This was especially evident when observing the interaction between individuals within the eight team-groups, and in the emergence of a number of students who provided

peer mentoring in areas where special expertise was required. This was not restricted to IT knowledge and skills, but encompassed a broad range of student learning support that included motivation, tips and tricks for presentation both using IT and for self-expression and coping with an audience, self-presentation (dress, appearance, voice), dealing with a disruptive audience, obtaining and using audience feedback, and many aspects of being a successful facilitator of learning. Many students commented during the debriefing session at the end of day one that this exercise had given them new tools and the confidence to use IT in ways that they had not been able to use before. Importantly, they reported that they had learned a great deal through the friendships and collaborative partnerships (with others in the cohort) that came about as a result of the group and individual interactions that the learning environment created in this multi-faceted authentic learning activity.

Following completion of Activity 2, the students commenced Activity 3, which required them to individually address an aspect of their own work situation that they would seek to develop or resolve. This part of the unit focused on individual use of the IT-based knowledge and skills acquired through Activity 1, while promoting peer support through mentoring and coaching. The ten-minute presentation and problem-solving documentation that each student was required to submit to the entire group was designed to represent the kinds of activities and IT tools that they would expect to use in the course of their everyday professional activities. Feedback during debriefing sessions at the conclusion of the unit confirmed that all of the students felt they had benefited from their experiences in the community of learning and activities that they had developed through undertaking this short unit.

Conclusion

Using the bridge-building group of activities, conducted in conjunction with the various computer tools that were integrated with the authentic tasks and collaborative team-based processes, proved to be a highly successful way of facilitating student learning in the context described here. The community of learning that developed provided a strong sense of team purpose, and willingness amongst the students to assist others, and to seek help when needed. Student feedback in debriefing sessions held at the end of each of the four days of the unit demonstrated the progressive evolution of a learning situation in which the students developed ownership of their own learning roles and refined independent ways for resolving authentic problems while maintaining collaborative links with others within the student cohort.

The classroom learning exercise reported here is founded on an approach that utilises authentic (real) tasks to engage students in problem solving and the use of IT tools. Both authors of this paper have used the principal real-task bridge-building activity with students in different discipline contexts. Using personal observations, feedback from students via unit comment sheets, and debriefing sessions, we have found it to be a highly successful way to engage students in authentic problem solving and team-based collaborative learning. Although reported here as implemented in a training and development context, the authors consider this approach may be successfully applied in other discipline contexts provided real problem-solving tasks are used to underpin the learning activities and planned learning outcomes.

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